

**INJURIES, ILLNESSES,
AND HAZARDOUS EXPOSURES
IN THE MINING INDUSTRY,
1986-1995:
A SURVEILLANCE REPORT**

U.S. Department of Health and Human Services
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health
Washington, DC

May 2000

Front cover photo by Earl Dotter ©

FOREWORD

This publication represents the first comprehensive surveillance report on injuries and illnesses in the U.S. mining industry. The tracking of occupational injuries, illnesses, and hazards, documents the Nation's progress in reducing the burden of work-related diseases and injuries and may help identify old and new problems that require additional research and prevention efforts. It is through surveillance data that we have been able to document that during the 20th century, deaths in the mining industry dropped approximately 37-fold and injury fatality rates have decreased approximately 13-fold, to 25 per 100,000 during 1996-1997. Much of this success can be attributed to research, which led to workplace interventions (such as safer equipment and improved ventilation), and regulations. Despite the progress that has been made in reducing the death and injury toll in mining, much work remains to be done.

The National Institute for Occupational Safety and Health is now the only federal agency with a mandate to conduct research and prevention activities for all the nation's workers, including the vital mining workforce. There are many challenges facing NIOSH in the field of mine safety and health in the new millennium. Traditional causes of injuries and fatalities and the potential for underground disasters still exist in U.S. mines today. For example, mine roof collapses account for a large portion of underground deaths and injuries. Respirable coal mine dust, which can lead to "black lung" disease, and harmful noise levels remain persistent health concerns. In addition, the introduction of new mining technologies may create new hazards not yet recognized in the field.

NIOSH is well positioned to meet these challenges and will continue to draw on its strong background of research, partnership, and prevention coupled with solutions-oriented engineering expertise. NIOSH will aggressively continue to develop the science and technology necessary to protect the safety and health of U.S. mine workers into the 21st century.

Linda Rosenstock, M.D., M.P.H.
Director

ACKNOWLEDGMENTS

This report was prepared primarily by Deborah D. Landen, Barbara Fotta, Richard C. Wang, Barbara D. Makowski, and Robert J. Tuchman of the Office for Mine Safety and Health Research, Pittsburgh Research Laboratory, and by Larry A. Layne of the Division of Safety Research, NIOSH.

Ted Lowe of the Office for Mining Safety and Health Research, Spokane Research Laboratory, and E. William Rossi of the Pittsburgh Research Laboratory created the maps. Janet M. Hale of the Division of Respiratory Disease Studies contributed analyses of occupational respiratory sampling data. Carol A. Burnett of the Division of Surveillance, Hazard Evaluations, and Field Studies contributed analyses of death certificate data. Lynette K. Hartle and Pamela K. Schumacher of the Division of Surveillance, Hazard Evaluations, and Field Studies, and Linda H. Plybon of the Education and Information Division assisted with coding of Mine Safety and Health Administration job titles into U.S. Bureau of the Census groupings. Lynn L. Rethi and Michael J. Brnich, Jr., of the Office for Mine Safety and Health Research, Pittsburgh Research Laboratory, assisted with classification of miners' work activities.

ABBREVIATIONS

ANSI	American National Standards Institute
BLS	U.S. Bureau of Labor Statistics
BOC	U.S. Bureau of the Census
CFOI	Census of Fatal Occupational Injuries
CFR	Code of Federal Regulations
CI	confidence interval
CPS	Current Population Survey
dB	decibel(s)
dba	decibel(s), A-weighted
hr	hour(s)
ICD	International Classification of Disease
ISO	International Organization for Standardization
kHz	kilohertz
L/min	liter(s) per minute
lb	pound(s)
mg	milligram(s)
mg/m ³	milligram(s) per cubic meter
MIPS	Mining Industry Population Survey
MRE	Mines Research Establishment
MSHA	Mine Safety and Health Administration
NCHS	National Center for Health Statistics
NEC	not elsewhere classified
NIOSH	National Institute for Occupational Safety and Health
NOHSM	National Occupational Health Survey of Mining
NOMS	National Occupational Mortality Surveillance
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
PMR	proportionate mortality ratio
SIC	Standard Industrial Classification
U.K.	United Kingdom
USBM	U.S. Bureau of Mines

CONTENTS

	<i>Page</i>
Foreword	i
Acknowledgments	ii
Abbreviations	iii
List of Tables and Figures	iv
Introduction	1
Chapter 1.—Fatal Injuries in the Mining Industry: Census of Fatal Occupational Injuries	2
Chapter 2.—Proportionate Mortality Ratios: National Occupational Mortality Surveillance Data	5
Chapter 3.—Employment and Active Mining Operations: MSHA Data	10
Chapter 4.—Fatal and Nonfatal Injuries: MSHA Data	17
4A Injuries in Coal Mining	25
4B Injuries in Metal Mining	45
4C Injuries in Nonmetal Mining	62
4D Injuries in Stone Mining	78
4E Injuries in Sand and Gravel Mining	95
Chapter 5.—Occupational Illnesses	111
Chapter 6.—Occupational Exposures	119
References	128
Appendix A.—Sources of Data	129
Appendix B.—Methods	131
Appendix C.—Work Activity Categories Used for Injuries in MSHA Accident, Injury, and Illness Database	132
Appendix D.—U.S. Bureau of the Census Occupation Divisions	135
Appendix E.—MSHA Accident Classifications	141

LIST OF TABLES AND FIGURES

Fatal Injuries in the Mining Industry: Census of Fatal Occupational Injuries

Figure 1-1. Percentage of fatal injuries in the mining industry by industry sector, 1992-1995.

Figure 1-2. Rate of fatal injuries (per 100,000 workers) in the mining industry by industry sector, and in all industries, 1992-1995.

Figure 1-3. Rates of fatal injuries (per 100,000 workers) by age group in the mining industry and in all industry, 1992-1995.

Table 1-1. Number and percent of fatal injuries by type of event for all U.S. industries and for the mining industry by sector, 1992-1995.

Proportionate Mortality Ratios: National Occupational Mortality Surveillance Data

Table 2-1. Male workers age 18 and older with usual industry on death certificate listed as coal mining, selected States: proportionate mortality ratios and 95% confidence intervals for selected ICD classified causes of death, 1986-1993; adjusted for age and race.

Table 2-2. Female workers age 18 and older with usual industry on death certificate listed as coal mining, selected States: proportionate mortality ratios and 95% confidence intervals for selected ICD classified causes of death, 1986-1993; adjusted for age and race.

Table 2-3. Male workers age 18 and older with usual industry on death certificate listed as metal mining, selected States: proportionate mortality ratios and 95% confidence intervals for selected ICD classified causes of death, 1986-1993; adjusted for age and race.

Table 2-4. Female workers age 18 and older with usual industry on death certificate listed as metal mining, selected States: proportionate mortality ratios and 95% confidence intervals for selected ICD classified causes of death, 1986-1993; adjusted for age and race.

Table 2-5. Male workers age 18 and older with usual industry on death certificate listed as nonmetallic mining and quarrying, selected States: proportionate mortality ratios and 95% confidence intervals for selected ICD classified causes of death, 1986-1993; adjusted for age and race.

Table 2-6. Female workers age 18 and older with usual industry on death certificate listed as nonmetallic mining and quarrying, selected States: proportionate mortality ratios and 95% confidence intervals for ICD classified causes of death, 1986-1993; adjusted for age and race.

Table 2-7. Male workers age 18 and older with usual industry on death certificate listed as petroleum and natural gas extraction, selected States: proportionate mortality ratios and 95% confidence intervals for ICD classified causes of death; adjusted for age and race.

Table 2-8. Female workers age 18 and older with usual industry on death certificate listed as petroleum and natural gas extraction, selected States: proportionate mortality ratios and 95% confidence intervals for ICD classified causes of death; adjusted for age and race.

Employment and Active Mining Operations: MSHA Data

Table 3-1. Number and percent of employee hours (in millions) by commodity and type of operation for operators, 1986-1995.

Figure 3-1. Locations of active mining operations, coal industry, 1995.

Figure 3-2. Coal operators: number of employee hours in millions and number of active mining operations by year, 1986-1995.

Figure 3-3. Locations of active metal mining operations, metal industry, 1995.

Figure 3-4. Metal operators: number of employee hours in millions and number of active mining operations by year, 1986-1995.

Figure 3-5. Locations of active mining operations, nonmetal industry, 1995.

Figure 3-6. Nonmetal operators: number of employee hours in millions and number of active mining operations by year, 1986-1995.

Figure 3-7. Locations of active mining operations, stone industry, 1995.

Figure 3-8. Stone operators: number of employee hours in millions and number of active mining operations by year, 1986-1995.

Figure 3-9. Locations of active mining operations, sand and gravel industry, 1995.

Figure 3-10. Sand and gravel operators: number of employee hours in millions and number of active mining operations by year, 1986-1995.

Figure 3-11. Coal industry: number of employee hours (in millions) for operators and contractors by year.

Figure 3-12. Metal, nonmetal, stone, and sand and gravel industries: number of employee hours (in millions) for operators and contractors by year, 1986-1995.

Fatal and Nonfatal Injuries: MSHA Data

Table 4-1. Mine operators and contractors: number and average annual rate of fatal injuries (per 100,000 full-time workers) by commodity, 1986-1995.

Table 4-2. Mine operators: number and average annual rate of fatal injuries (per 100,000 full-time workers) by commodity and subunit, 1986-1995.

Table 4-3. Mine operators: number and average annual rate of fatal injuries (per 100,000 full-time workers) for the 10 occupation-commodity groups with the highest fatal injury rates.

Table 4-4. Mine operators: number and percent of fatal injuries by commodity and work activity, 1986-1995.

Table 4-5. Mine operators: number and percent of fatal injuries by MSHA accident classification and commodity, 1986-1995.

Table 4-6. Mine operators and contractors: number and average annual rate of nonfatal injuries (per 100 full-time workers) by commodity, 1986-1995.

Table 4-7. Mine operators: number and average annual rate of nonfatal injuries (per 100 full-time workers) by commodity and subunit, 1986-1995.

Figure 4-1. Mine operators: rate of nonfatal injury (per 100 full-time workers) by commodity and year, 1986-1995.

Table 4-8. Mine operators: percent of injuries and mean days lost work for the 4 leading types of injury by commodity.

Table 4-9. Mine operators: percent of injuries and mean days lost work for the 4 leading work activities by commodity.

Figure 4-2. Body part affected for strain injuries, all commodities combined, 1986-1995.

Figure 4-3. Body part affected for nonstrain injuries, all commodities combined, 1986-1995.

Injuries in Coal Mining: MSHA Data

Figure 4A-1. Coal operators: number and rate (per 100,000 workers) of fatal injuries by year, 1986-1995.

Table 4A-1. Coal operators: number and average annual rate (per 100,000 workers) of fatal injuries by subunit, 1986-1995.

Figure 4A-2. Coal operators: number and rate (per 100,000 workers) of fatal injuries by U.S. Bureau of the Census Occupation Division, 1986-1995.

Figure 4A-3. Coal operators: percent of fatal injuries by work activity, 1986-1995.

Figure 4A-4. Coal operators: number of fatal injuries by MSHA accident classification, 1986-1995.

Figure 4A-5. Coal operators: number and rate (per 100 workers) of nonfatal injuries by year, 1986-1995.

Table 4A-2. Coal operators: number and average annual rate (per 100 workers) of nonfatal injuries by subunit, 1986-1995.

Figure 4A-6. Coal operators: median values for age, total mining experience, experience in current mine, and experience in current job for workers with nonfatal injuries by year, 1986-1995.

Table 4A-3. Coal operators: nonfatal injuries, 1986-1995, by nature of injury. Number of cases, percentage of cases with one or more lost workdays, mean days lost work per case, total days work lost for all cases, and statutory days charged for all cases.

Table 4A-4. Coal operators: nonfatal injuries, 1986-1995, by work activity. Number of cases, percentage of cases with one or more lost workdays, mean days lost work per case, total days work lost for all cases, and statutory days charged for all cases.

Figure 4A-7. Coal operators: nonfatal injuries, 1986-1995. Number and rate (per 100 workers) of strain and nonstrain injuries by year.

Figure 4A-8. Coal operators: nonfatal injuries, 1986-1995. Rate (per 100 workers) of strain and nonstrain injuries by U.S. Bureau of the Census Occupation Division.

Figure 4A-9. Coal operators: number of (nonfatal) strain injuries by body part injured, 1986-1995.

Figure 4A-10. Coal operators: number of (nonfatal) nonstrain injuries by body part injured, 1986-1995.

Figure 4A-11. Coal operators: number of nonfatal injuries by MSHA accident classification, 1986-1995.

Figure 4A-12. Coal operators: nonfatal material handling injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4A-13. Coal operators: nonfatal fall injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

- Figure 4A-14. Coal operators: nonfatal hand tool injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.
- Figure 4A-15. Coal operators: nonfatal powered haulage injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.
- Figure 4A-16. Coal operators: nonfatal machine injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.
- Figure 4A-17. Coal operators: nonfatal electrical injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.
- Figure 4A-18. Coal contractors: number and rate of fatal injuries (per 100,000 workers) by year.
- Table 4A-5. Coal contractors: number and average annual rate (per 100,000 workers) of fatal injuries by subunit, 1986-1995.
- Figure 4A-19. Coal contractors: number of fatal injuries by U.S. Bureau of the Census Occupation Division, 1986-1995.
- Figure 4A-20. Coal contractors: percent of fatal injuries by work activity, 1986-1995.
- Figure 4A-21. Coal contractors: number of fatal injuries by MSHA accident classification, 1986-1995.
- Figure 4A-22. Coal contractors: number and rate (per 100 workers) of nonfatal injuries by year.
- Table 4A-6. Coal contractors: number and average annual rate (per 100 workers) of nonfatal injuries by subunit, 1986-1995.
- Figure 4A-23. Coal contractors: number of nonfatal injuries by MSHA accident classification, 1986-1995.

Injuries in Metal Mining: MSHA Data

- Figure 4B-1. Metal operators: number and rate (per 100,000 workers) of fatal injuries by year, 1986-1995.
- Table 4B-1. Metal operators: number and average annual rate (per 100,000 workers) of fatal injuries by subunit, 1986-1995.
- Figure 4B-2. Metal operators: number and rate (per 100,000 workers) of fatal injuries by U.S. Bureau of the Census Occupation Division, 1986-1995.
- Figure 4B-3. Metal operators: number of fatal injuries by work activity, 1986-1995.
- Figure 4B-4. Metal operators: number of fatal injuries by MSHA accident classification, 1986-1995.
- Figure 4B-5. Metal operators: number and rate (per 100 workers) of nonfatal injuries by year, 1986-1995.
- Table 4B-2. Metal operators: number and average annual rate (per 100 workers) of nonfatal injuries by subunit, 1986-1995.
- Figure 4B-6. Metal operators: median values for age, total mining experience, experience in current mine, and experience in current job for workers with nonfatal injuries by year, 1986-1995.
- Table 4B-3. Metal operators: nonfatal injuries, 1986-1995, by nature of injury. Number of cases, percentage of cases with one or more lost workdays, mean days lost work per case, total days work lost for all cases, and statutory days charged for all cases.
- Table 4B-4. Metal operators: nonfatal injuries, 1986-1995, by work activity. Number of cases, percentage of cases with one or more lost workdays, mean days lost work per case, total days work lost for all cases, and statutory days charged for all cases.
- Figure 4B-7. Metal operators: nonfatal injuries 1986-1995. Number and rate (per 100 workers) of strain and nonstrain injuries by year, 1986-1995.
- Figure 4B-8. Metal operators: nonfatal injuries 1986-1995. Number and rate (per 100 workers) of strain and nonstrain injuries by U.S. Bureau of the Census Occupation Division, 1986-1995.
- Figure 4B-9. Metal operators: number of (nonfatal) strain injuries by body part injured, 1986-1995.
- Figure 4B-10. Metal operators: number of (nonfatal) nonstrain injuries by body part injured, 1986-1995.
- Figure 4B-11. Metal operators: number of nonfatal injuries by MSHA accident classification, 1986-1995.
- Figure 4B-12. Metal operators: nonfatal material handling injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.
- Figure 4B-13. Metal operators: nonfatal fall injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.
- Figure 4B-14. Metal operators: nonfatal hand tool injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.
- Figure 4B-15. Metal operators: nonfatal machine injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.
- Figure 4B-16. Metal operators: nonfatal powered haulage injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4B-17. Metal operators: nonfatal electrical injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Injuries in Nonmetal Mining: MSHA Data

Figure 4C-1. Nonmetal operators: number and rate (per 100,000 workers) of fatal injuries by year, 1986-1995.

Table 4C-1. Nonmetal operators: number and average annual rate (per 100,000 workers) of fatal injuries by subunit, 1986-1995.

Figure 4C-2. Nonmetal operators: number and rate (per 100,000 workers) of fatal injuries by U.S. Bureau of the Census Occupation Division, 1986-1995.

Figure 4C-3. Nonmetal operators: percent of fatal injuries by work activity, 1986-1995.

Figure 4C-4. Nonmetal operators: number of fatal injuries by MSHA accident classification, 1986-1995.

Figure 4C-5. Nonmetal operators: number and rate (per 100 workers) of nonfatal injuries by year, 1986-1995.

Table 4C-2. Nonmetal operators: number and average annual rate (per 100 workers) of nonfatal injuries by subunit, 1986-1995.

Figure 4C-6. Nonmetal operators: median values for age, total mining experience, experience in current mine, and experience in current job for workers with nonfatal injuries by year, 1986-1995.

Table 4C-3. Nonmetal operators: nonfatal injuries, 1986-1995, by nature of injury. Number of cases, percentage of cases with one or more lost workdays, mean days lost work per case, total days work lost for all cases, and statutory days charged for all cases.

Table 4C-4. Nonmetal operators: nonfatal injuries, 1986-1995, by work activity. Number of cases, percentage of cases with one or more lost workdays, mean days lost work per case, total days work lost for all cases, and statutory days charged for all cases.

Figure 4C-7. Nonmetal operators: nonfatal injuries 1986-1995. Number and rate (per 100 workers) of strain and nonstrain injuries by year, 1986-1995.

Figure 4C-8. Nonmetal operators: nonfatal injuries, 1986-1995. Rate (per 100 workers) of strain and nonstrain injuries by U.S. Bureau of the Census Occupation Division, 1986-1995.

Figure 4C-9. Nonmetal operators: number of (nonfatal) strain injuries by body part injured, 1986-1995.

Figure 4C-10. Nonmetal operators: number of (nonfatal) nonstrain injuries by body part injured, 1986-1995.

Figure 4C-11. Nonmetal operators: number of nonfatal injuries by MSHA accident classification, 1986-1995.

Figure 4C-12. Nonmetal operators: nonfatal material handling injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4C-13. Nonmetal operators: nonfatal fall injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4C-14. Nonmetal operators: nonfatal hand tool injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4C-15. Nonmetal operators: nonfatal machine injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4C-16. Nonmetal operators: nonfatal powered haulage injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4C-17. Nonmetal operators: nonfatal electrical injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Injuries in Stone Mining: MSHA Data

Figure 4D-1. Stone operators: number and rate (per 100,000 workers) of fatal injuries by year, 1986-1995.

Table 4D-1. Stone operators: number and average annual rate (per 100,000 workers) of fatal injuries by subunit, 1986-1995.

Figure 4D-2. Stone operators: number and rate (per 100,000 workers) of fatal injuries by U.S. Bureau of the Census Occupation Division, 1986-1995.

Figure 4D-3. Stone operators: number of fatal injuries by work activity, 1986-1995.

Figure 4D-4. Stone operators: number of fatal injuries by MSHA accident classification, 1986-1995.

Figure 4D-5. Stone operators: number and rate (per 100 workers) of nonfatal injuries by year, 1986-1995.

Table 4D-2. Stone operators: number and average annual rate (per 100 workers) of nonfatal injuries by subunit, 1986-1995.

Figure 4D-6. Stone operators: median values for age, total mining experience, experience in current mine, and experience in current job for workers with nonfatal injuries by year, 1986-1995.

Table 4D-3. Stone operators: nonfatal injuries, 1986-1995, by nature of injury. Number of cases, percentage of cases with one

or more lost workdays, mean days lost work per case, total days work lost for all cases, and statutory days charged for all cases.

Table 4D-4. Stone operators: nonfatal injuries, 1986-1995, by work activity. Number of cases, percentage of cases with one or more lost workdays, mean days lost work per case, total days work lost for all cases, and statutory days charged for all cases.

Figure 4D-7. Stone operators: nonfatal injuries 1986-1995. Number and rate (per 100 workers) of strain and nonstrain injuries by year, 1986-1995.

Figure 4D-8. Stone operators: nonfatal injuries, 1986-1995. Rate (per 100 workers) of strain and nonstrain injuries by U.S. Bureau of the Census Occupation Division, 1986-1995.

Figure 4D-9. Stone operators: number of (nonfatal) strain injuries by body part injured, 1986-1995.

Figure 4D-10. Stone operators: number of (nonfatal) nonstrain injuries by body part injured, 1986-1995.

Figure 4D-11. Stone operators: number of nonfatal injuries by MSHA accident classification, 1986-1995.

Figure 4D-12. Stone operators: nonfatal material handling injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4D-13. Stone operators: nonfatal fall injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4D-14. Stone operators: nonfatal hand tool injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4D-15. Stone operators: nonfatal machine injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4D-16. Stone operators: nonfatal powered haulage injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4D-17. Stone operators: nonfatal electrical injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Injuries in Sand and Gravel Mining: MSHA Data

Figure 4E-1. Sand and gravel operators: number and rate (per 100,000 workers) of fatal injuries by year, 1986-1995.

Table 4E-1. Sand and gravel operators: number and average annual rate (per 100,000 workers) of fatal injuries by subunit, 1986-1995.

Figure 4E-2. Sand and gravel operators: number and rate (per 100,000 workers) of fatal injuries by U.S. Bureau of the Census Occupation Division, 1986-1995.

Figure 4E-3. Sand and gravel operators: number of fatal injuries by work activity, 1986-1995.

Figure 4E-4. Sand and gravel operators: number of fatal injuries by MSHA accident classification, 1986-1995.

Figure 4E-5. Sand and gravel operators: number and rate (per 100 workers) of nonfatal injuries by year, 1986-1995.

Table 4E-2. Sand and gravel operators: number and average annual rate (per 100 workers) of nonfatal injuries by subunit, 1986-1995.

Figure 4E-6. Sand and gravel operators: median values for age, total mining experience, experience in current mine, and experience in current job for workers with nonfatal injuries by year, 1986-1995.

Table 4E-3. Sand and gravel operators: nonfatal injuries, 1986-1995, by nature of injury. Number of cases, percentage of cases with one or more lost workdays, mean days lost work per case, total days work lost for all cases, and statutory days charged for all cases.

Table 4E-4. Sand and gravel operators: nonfatal injuries, 1986-1995, by work activity. Number of cases, percentage of cases with one or more lost workdays, mean days lost work per case, total days work lost for all cases, and statutory days charged for all cases.

Figure 4E-7. Sand and gravel operators: nonfatal injuries 1986-1995. Number and rate (per 100 workers) of strain and nonstrain injuries by year, 1986-1995.

Figure 4E-8. Sand and gravel operators: nonfatal injuries, 1986-1995. Rate (per 100 workers) of strain and nonstrain injuries by U.S. Bureau of the Census Occupation Division, 1986-1995.

Figure 4E-9. Sand and gravel operators: number of (nonfatal) strain injuries by body part injured, 1986-1995.

Figure 4E-10. Sand and gravel operators: number of (nonfatal) nonstrain injuries by body part injured, 1986-1995.

Figure 4E-11. Sand and gravel operators: number of nonfatal injuries by MSHA accident classification, 1986-1995.

Figure 4E-12. Sand and gravel operators: nonfatal material handling injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4E-13. Sand and gravel operators: nonfatal fall injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4E-14. Sand and gravel operators: nonfatal hand tool injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4E-15. Sand and gravel operators: nonfatal machine injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4E-16. Sand and gravel operators: nonfatal powered haulage injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Figure 4E-17. Sand and gravel operators: nonfatal electrical injuries, 1986-1995. Percent of injuries by event resulting in injury and by source of injury.

Occupational Illnesses

Figure 5-1. Coal operators: percent of illness conditions reported by nature of condition, 1986-1995.

Figure 5-2. Coal operators: rates of illness conditions reported (per 100,000 workers) for selected conditions by year, 1986-1995.

Figure 5-3. Coal contractors: percent of illness conditions reported by nature of condition, 1986-1995.

Figure 5-4. Metal operators: percent of illness conditions reported by nature of condition, 1986-1995.

Figure 5-5. Metal operators: rates of illness conditions reported (per 100,000 workers) for selected conditions by year, 1986-1995.

Figure 5-6. Nonmetal operators: percent of illness conditions reported by nature of condition, 1986-1995.

Figure 5-7. Nonmetal operators: rates of illness conditions reported (per 100,000 workers) for selected conditions by year, 1986-1995.

Figure 5-8. Stone operators: percent of illness conditions reported by nature of condition, 1986-1995.

Figure 5-9. Stone operators: rates of illness conditions reported (per 100,000 workers) for selected conditions by year, 1986-1995.

Figure 5-10. Sand and gravel operators: percent of illness conditions reported by nature of condition, 1986-1995.

Figure 5-11. Sand and gravel operators: rates of illness conditions reported (per 100,000 workers) for selected conditions by year, 1986-1995.

Figure 5-12. Percent of coal miners with NIOSH-defined hearing impairment by age compared to the percent of the nonoccupationally noise-exposed population having hearing impairment as calculated from ISO-1999.

Figure 5-13. Percent of male metal/nonmetal miners with NIOSH-defined hearing impairment by age compared to the percent of the nonoccupationally noise-exposed male population having hearing impairment as calculated from ISO-1999.

Occupational Exposures

Table 6-1. Dust samples, 1986-1995. Number of samples, number and percent under permissible exposure limit (PEL), number and percent 1-2 times PEL, and number and percent 2 or more times PEL.

Table 6-2. Metal industry: metal fume samples, 1986-1995. Number of samples, number and percent under permissible exposure limit (PEL), number and percent 1-2 times PEL, and number and percent 2 or more times PEL.

Table 6-3. Nonmetal industry: metal fume samples, 1986-1995. Number of samples, number and percent under permissible exposure limit (PEL), number and percent 1-2 times PEL, and number and percent 2 or more times PEL.

Table 6-4. Stone industry: metal fume samples, 1986-1995. Number of samples, number and percent under permissible exposure limit (PEL), number and percent 1-2 times PEL, and number and percent 2 or more times PEL.

Table 6-5. Sand and gravel industry: metal fume samples, 1986-1995. Number of samples, number and percent under permissible exposure limit (PEL), number and percent 1-2 times PEL, and number and percent 2 or more times PEL.

Table 6-6. Coal industry: MSHA "dual-threshold" study, 1991-1995. Number of samples by occupation, percent of samples over 90 dBA based on 90-dBA threshold for time-weighted average, and percent of samples over 85 dBA based on 80-dBA threshold for time-weighted average.

Table 6-7. Metal/nonmetal industry: MSHA "dual-threshold" study, 1991-1994. Number of samples by occupation, percent of samples over 90 dBA based on 90-dBA threshold for time-weighted average, and percent of samples over 85 dBA based on 80-dBA threshold for time-weighted average.

Table 6-8. Operational definitions for musculoskeletal overload conditions in the National Occupational Health Survey of Mining (NOHSM).

Table 6-9. Percent of workers potentially exposed to musculoskeletal overload conditions by condition and commodity, National Occupational Health Survey of Mining (NOHSM), 1984-1989.

INTRODUCTION

This surveillance report summarizes data on work-related fatal and nonfatal injuries, illnesses, and hazardous exposures in the mining industry for the 10-year period 1986-1995. The term “surveillance,” as used in public health, may be new to many readers of this report. With regard to occupational safety and health, the goal of surveillance is to describe the occurrence of work-related injuries, illnesses, and known hazardous exposures; to identify new hazards that may occur due to the introduction of new technology or other factors; and to assess the effects of preventive measures designed to improve worker safety and health. Surveillance provides an overall picture, which can be used to focus resources on areas most in need of prevention programs or further research.

Surveillance generally requires the use of multiple sources of data, all of which have their own strengths and limitations. Surveillance in the U.S. mining industry is complicated by the fact that U.S. national data systems that provide information on mining are based on *two different definitions of the mining industry*. One is established by the Mine Safety and Health Administration (MSHA), the other by the Standard Industrial Classification (SIC) System [Office of Management and Budget 1987] and the 1980 U.S. Bureau of the Census (BOC) Classification System [U.S. Bureau of the Census 1982].

The mining industry as defined by MSHA is based on the regulatory jurisdiction of that agency. Reporting requirements for injuries, illnesses, and workplace exposures are stipulated under the Federal Coal Mine Health and Safety Act of 1969 and the Federal Mine Safety and Health Amendments Act of 1977. Of note is that the oil and gas extraction industry falls outside of MSHA jurisdiction. The Occupational Safety and Health Administration (OSHA) was charged with enforcement in the oil and gas industry under the Occupational Safety and Health Act of 1970.

Under the SIC, the definition of mining covers the extraction of naturally occurring minerals, including liquids (petroleum), gases (natural gas) and solids (coal, metal, and nonmetallic minerals). Exploration and development of mineral properties are also included in the SIC definition of the mining industry. The SIC was developed by the Office of Management and Budget for use in classifying establishments based on the type of economic activity in which they are engaged and serves as the industry classification standard for all establishment-based Federal economic statistics. This classification is important for occupational safety and health surveillance because it also serves as the industry classification system for all data on work-related injuries and illnesses collected by the U.S. Bureau of Labor Statistics (BLS).

The U.S. Bureau of the Census uses an industry coding scheme similar to that used by the SIC. For the mining

industry, the categorization is identical in both systems. Death certificate data made available by the National Center for Health Statistics (NCHS) are categorized under this system. Death certificate data are particularly important for surveillance of mortality from work-related illnesses.

Key differences between the SIC/BOC categorization system and the MSHA system can be summarized as follows:

- MSHA excludes the oil and gas industry, which is classified as part of the mining industry under SIC/BOC.
- MSHA excludes work that is done off of mine property; work off of mine property is included under SIC/BOC if it is performed by an establishment falling into one of the SIC/BOC mining industry codes.
- MSHA includes mine-associated mills and processing plants; these are classified under the manufacturing industry, rather than mining, according to the SIC/BOC coding structure.

Since the data collected by MSHA and the data collected by BLS and NCHS using the SIC/BOC classification system are both important sources of information on the mining industry and in many cases serve different purposes, data from both systems are presented in this report. In general, data using the SIC/BOC system are comparable across U.S. industries and should be used when comparing mining to other U.S. industries.

Much of the data in this report are presented in the form of frequencies or rates. A frequency provides only a count of the number of cases without providing any information about the risk of occurrence. Rates provide an estimate of the risk of injury or illness. *The reader is cautioned, however, that rates based on small numbers can be unstable; thus, any inferences should be drawn with care.* In this report, no rates are presented for groups in which there were fewer than three cases.

The incidence of most injury and illness conditions differs by age, sex, and race. For this reason, data in many surveillance reports are adjusted for these demographic factors. It was not possible to do this for most of the rates in this report because information on demographics was not available. With the exception of the proportionate mortality ratios (PMRs), all data presented are unadjusted.

A detailed account of the sources of data is in appendix A. The methods used in data selection and analysis are described in appendix B.